Human-Centered Design and User Experience, Vol. 114, 2023, 531–537
https://doi.org/10.54941/ahfe1004272

Exploring the User's Perception of Updates in Intelligent Systems

Youyu Sheng[1,2,3], Xing Chen[4], Yuhan Liu[5], and Jingyu Zhang[1,2]

[1]CAS Key Laboratory of Behavioural Science, Institute of Psychology, Beijing 100000, China
[2]Department of Psychology, University of Chinese Academy of Sciences, Beijing 100000, China
[3]The Hong Kong University of Science and Technology (Guangzhou), Guangdong 510000, China
[4]Chongqing Chang'an Automobile Co., Ltd, Chongqing 400000, China
[5]School of Social and Behavioral Sciences, Nanjing University, Nanjing 210000, China

ABSTRACT

With the rapid advancements in artificial intelligence and connected systems, understanding users' perceptions becomes crucial. This study delved into the "Perception of Updates" in intelligent systems, combining expert and user interviews to elucidate the various facets of perceived system upgrades. For a deeper dive, semi-structured interviews were carried out with experts and users alike. The expert group consisted of professionals from diverse fields, including user experience, product design, intelligent vehicle design, voice system specialists, and academics, all of whom have substantial experience in the domain. Key insights from these sessions ranged from the evaluation of intelligent product upgrades to discerning design recommendations under perceived enhancements. On the other hand, user interviews engaged 20 users with experience in using intelligent products. The focal point here was their experiences and recall of moments when they distinctly perceived an update or progression in the intelligence of the systems they used. Emerging from these interviews were structural analyses of the perception of updates. Three primary dimensions were discerned: enhancement of perceived functions, addition of new functions, and perceived evolutionary capabilities of the system. Notably, there were also implications on the effects of this perception. Positive outcomes included increased trust in the product, heightened purchase intentions, brand loyalty, a sense of security, and a propensity to recommend the product to peers. Interestingly, among user interviewees, the perception most significantly influenced product recommendations and brand loyalty. Meanwhile, experts highlighted the implications on brand loyalty and trust, reinforcing the intrinsic link between perceived updates and continued user engagement. However, there were also potential drawbacks to consider, such as concerns over privacy and perceived threats, though these were less frequently mentioned. This study highlights the importance of understanding user perceptions of system updates, offering valuable insights for improving user experience in modern technology.

Keywords: Perception of updates, Intelligent systems, Experts interview, Users interview

INTRODUCTION

With the rapid evolution of the digital age, society is undergoing transformative changes. Autonomous vehicles and intelligent robots, distinct from traditional "automation", exemplify this shift (Hancock, 2020). These "autonomous" systems exhibit advanced learning capabilities, adjusting based on user behaviour, environmental cues, and continuously updated user profiles. This dynamism, marked by unpredictability and a high degree of independence, signals a pivotal turn in our relationship with technology, transitioning from utilitarian interactions to forming prolonged, intricate relationships with autonomous entities (De Visser et al., 2018).

Historical research, however, indicates that humans inherently view machines as static and immutable entities (Muir & Moray, 1996). Such perceptions, deeply rooted in implicit cognition, can impede users' trust and acceptance of newer technologies. This cognitive bottleneck accentuates the urgency of enhancing the "perception of update" among users. A lucid recognition of technological enhancements can significantly bolster user trust and deepen their engagement with these advanced systems (Billings, 1994; Parasuraman & Wickens, 2017).

Despite the importance of understanding this "perception of update," previous research has not provided a comprehensive concept, along with its influencing factors and effects. And the majority focusing primarily on hardware advancements while neglecting the nuanced changes brought about by evolving capability modes (De Visser et al., 2018).

To bridge this research gap, this study would employ a combination of expert interviews and user interviews to construct and validate a conceptual framework for the "perception of update." The prevailing vagueness regarding its definition, implications, and underlying mechanisms mandates a thorough approach, which this research aims to provide, integrating expert and user interviews to initially identify its composition, influential mechanisms, and eventual outcomes.

METHODS

Expert Interview

For the expert interviews, we involved a total of 10 experts: 3 user experience experts, 3 intelligent product design experts, 2 intelligent voice assistant experts, and 2 professors in intelligent systems. We used a semi-structured interview approach, each lasting between 30 minutes. The interviews mainly aimed to gather views on the perception of updates in intelligent products. Additionally, we asked for advice on designing intelligent systems in a way that makes it clear to users that these systems can learn and evolve. A typical question we posed was: "When designing intelligent systems, how can we make users feel that the system has the ability to learn and get better?"

User Interview

We invited 20 users (11 males and 9 females; average age of 29.25 years) who have over a year of experience using intelligent products, including

smart cars, smart speakers, and other smart household appliances. We used a semi-structured interview approach, each lasting between 30 minutes. The interviews mainly revolved around recollections of scenarios where they perceived upgrades in intelligent products. For instance, we asked: "Considering the smart products (like smart cars, smart speakers, robots, etc.) you've encountered in your life, can you recall a situation where you felt a significant improvement in the system, giving you the impression that it was learning or even evolving?" Participants also provided their insights on the design and reasons behind the perceived upgrades of smart products.

Finally, based on these interviews, two researchers worked independently to form the structure, factors, and effects of "Perception of Update" through discussion and text polishing. The Kendall concordance coefficient of the internal reliability of raters was greater than 0.90.

RESULTS

Structure of Perception of Update

Based on the interviews with experts and users, scenarios and situations that indicated a perception of updates were categorized. As outlined in Table 1, an initial model was derived, structured around three main aspects: enhancement of perceptual functions, addition of new functions, and the capability for perceptual evolution.

Table 1. The structure of perception of update.

First-level subdimension	Second-level subdimension	Explanation
Enhancement of perceived functions	Solve in time	The original problem was solved.
	Optimize in time	The original function works better.
	Beautify in time	The original interface looks better.
Addition of new functions	Usability	It adds a new easy-to-use function.
	Novelty	It adds a new cool function.
	Usefulness	It adds a new useful function.
Perceived evolutionary capacity	Autonomous improvement	I feel the system can improve itself.
	Autonomous growth	I feel the system is growing.
	Autonomous evolution	I feel the system is evolving.

Factors Influencing the Perception of Update

From the expert and user interviews, factors influencing the perception of update were categorized. As depicted in Table 2, a preliminary model was formed, defining three main influencing layers: changes in system capabilities, features of interaction design, and user characteristics. The changes in system capabilities are understood from three perspectives: improvement in task performance, enhancement of social capabilities, and fulfilment of individual needs. Interaction design features that impact the perception of

update include designs emphasizing clear improvements, designs encouraging user participation during the upgrade process, and designs focusing on the rhythm of the update process. Lastly, user characteristics that influence the perception of update encompass aspects like personality traits, beliefs, and past usage experiences.

Within each secondary influence factor, there are multiple tertiary factors. For instance, within the system capabilities change, the impact of task performance improvement relates to the enhancement and addition of task functionalities, the naturalness of system interaction, and the system's comprehensibility. In interaction design features, the emphasis on clear improvements touches upon highlighting enhanced functionalities and visualization. As for user characteristics, the effect of personality traits revolves around the user's curiosity and inclination toward new technologies.

Table 2. The factors of perception of update.

First-level contributing factor	Second-level contributing factor	Third-level contributing factor
Change in system capacity	Task performance improvement	Increase and enhancement of task function
		Natural interaction
		Perceived understandability
	Social competence improvement	Agreeableness
		Anthropomorphism
	Personalized need gratification	Personalized condition
		Personalized users' habit
		Personalized users' state
		Personalized users' relationship
Features of interaction design	Designed to enhance visibility	Highlight new functions
		Improve visualization
	Designed to enhance process involvement	User engagement
	Designed to enhance process rhythm	Rhythm of system update
User characteristics	Personality trait	Curiosity
		Inclination toward new technologies
	Belief	Belief for upgrade
	Past usage experiences	Product familiarity

Effects of the Perception of Update

Expert and user interviews were also analysed to understand the consequences of the perception of update. As shown in Table 3, positive outcomes include trust, purchase intent, brand loyalty, perception of security, and product recommendations. Within the user group interviews, it was discovered that the perception of update significantly influenced product recommendations and brand loyalty. Specifically, if users felt an update in the product and had a good experience, they were more likely to incorporate it into their habits and actively recommend the product to their friends.

Nevertheless, among the outcomes of the perception of update, there were negative results such as concerns over privacy and feelings of threat, though these were less frequently mentioned by both user and expert groups.

Table 3. The effect of perception of update.

Effect	Explanation
Positive	
Trust	Users develop trust and increase utilization with continuous product upgrades.
Purchase intention	Users are more likely to buy the product and its peripherals.
Brand loyalty	It influences user habits and increases loyalty to the product.
Perception of security	Users can use the product with more confidence.
Product recommendation	Users will actively recommend the product to their friends.
Negative	
Privacy concern	Users' trust in the product will be affected by privacy concerns.
Feelings of Threat	As the intelligent agents become more autonomous and subjective, users will consider legal and ethical issues.

DISCUSSION

The findings from this study shed light on the multifaceted nature of the "perception of update." This perception is not merely about the addition or enhancement of features; it dives into the end-user's deeper understanding and the sense of the system's evolving capabilities. The emergence of three distinct aspects – enhancement, addition, and evolution of perceptual functions – emphasizes the depth and breadth of how updates are perceived. This suggests the importance of addressing each of these facets when designing and deploying intelligent system updates.

Furthermore, the range of factors influencing the perception of update is extensive and varied. The results underscore the importance of clear, user-centric design choices (Norman, 2013). Such designs should not only showcase the upgrades but also actively involve the user, ensuring they are aware of and appreciate the system's growth. The rhythm of the upgrade process signifies that users value not just the end result but also the journey and narrative of progress (Gong et al., 2021).

Interestingly, while system capability changes are anticipated to be a significant determinant, user characteristics like beliefs, past usage experiences, and personality traits also play a pivotal role in shaping the perception of update. This underscores a level of subjectivity in the perception of updates, indicating that updates might not be universally perceived in the same manner across all users (Karapanos et al., 2009).

On the positive outcomes side, it is undeniable that an optimistic perception of updates can lead to increased trust, brand loyalty, and product

recommendations. The robust connection between the perception of update and brand loyalty, especially observed among expert participants, underscores its business implications. Effectively managing system updates is not just about refining the product; it's about nurturing and deepening relationships with users. The fact that users are likely to incorporate the updated product into their daily habits and even advocate for it among peers is significant. This showcases that the perception of update can be a potent tool for organic growth and word-of-mouth marketing.

However, despite the overwhelmingly positive outcomes, it's essential to consider the potential negative perceptions. Although mentioned less frequently, concerns about privacy and feelings of threat are consistent with the ongoing discourse about AI and intelligent systems. As systems evolve in their complexity, striking a balance in maintaining transparency becomes a challenge (Endsley, 2023). Ensuring that users remain comfortable and not overwhelmed or wary of the technology they're engaging with is crucial.

Looking forward, there are several potential avenues for further exploration. First and foremost, the model derived from the interviews necessitates rigorous validity and reliability assessments. By honing well-defined constructs, subsequent studies could delve into psychometric evaluations facilitated by expansive questionnaires (Mohseni et al., 2021). This approach would not only refine the model but also bolster its empirical strength and ensure its applicability across a spectrum of populations. Additionally, given the rapidly changing technological landscape, it's essential to consider that perceptions surrounding updates might also evolve. Longitudinal studies that monitor these changing perceptions over prolonged periods could offer invaluable insights into this dynamic phenomenon.

CONCLUSION

In conclusion, the perception of updates in intelligent systems serves as a driving factor in influencing user trust, loyalty, and satisfaction. This research underscores the need for developers and designers to prioritize perceptible upgrades in their systems, ensuring users not only enjoy the enhanced features but also continue to trust and engage with the evolving technology.

ACKNOWLEDGMENT

The study was funded by National Natural Science Foundation of China: Grant No. T2192932.

REFERENCES

Billings, C. E. (1994). Concerns about Adaptive Automation in Aviation Domains. Human performance in automated systems: Current research and trends.

De Visser, E. J., Pak, R., & Shaw, T. H. (2018). From 'automation' to 'autonomy': the importance of trust repair in human–machine interaction. Ergonomics, 61(10), 1409–1427.

Endsley, M. R. (2023). Supporting Human-AI Teams: Transparency, explainability, and situation awareness. Computers in Human Behavior, 140, 107574.

Gong, X., Razzaq, A., & Wang, W. (2021). More haste, less speed: How update frequency of mobile apps influences consumer interest. Journal of theoretical and applied electronic commerce research, 16(7), 2922–2942.

Hancock, P. A. (2020). Imposing limits on autonomous systems. In New Paradigms in Ergonomics (pp. 134–141). Routledge.

Karapanos, E., Zimmerman, J., Forlizzi, J., & Martens, J.-B. (2009). User experience over time: an initial framework. Proceedings of the SIGCHI conference on human factors in computing systems.

Mohseni, S., Zarei, N., & Ragan, E. D. (2021). A multidisciplinary survey and framework for design and evaluation of explainable AI systems. ACM Transactions on Interactive Intelligent Systems (TiiS), 11(3-4), 1–45.

Muir, B. M., & Moray, N. (1996). Trust in automation. Part II. Experimental studies of trust and human intervention in a process control simulation. Ergonomics, 39(3), 429–460.

Norman, D. (2013). The design of everyday things: Revised and expanded edition. Basic books.

Parasuraman, R., & Wickens, C. D. (2017). Humans: Still vital after all these years of automation. In Decision Making in Aviation (pp. 251–260). Routledge.